Abstracts

Andrew Carverhill, School of Business, HKU

Affine-Jump Filtering of Transactions Intensity

We present an "affine" model for the frequency (intensity) of trading of a security, modeled as a Poisson Point process, and then we show how to filter the intensity from observations of the trading. In the 1 factor version of our model, the trading intensity ξ_t obeys the Ito equation $d\xi_t = \kappa(\bar{\xi} - \xi_t)dt + \sigma\sqrt{\xi_t}dW_t$, in which $\kappa, \bar{\xi}, \sigma$ are positive constants, and dW_t is the differential increment of standard Brownian Motion.

We present the model with many factors, and implement it with 1 and 2 factors, on actual stock transactions, and on simulated data, and compare it with the Autoregressive Conditional Duration (ACD) model of Engle and Russell. Our model explicitly recognizes the standard error in the filtered estimates, via a non-linear Ricatti equation. However, our model does not fit well to the actual data, and we conclude that it is not robust with respect to model mis-specification. We thus simplify the Ricatti equation for the standard error, introducing minimal biases, and then our model performs comparably with the ACD Model, while explicitly giving the standard errors.

Kani Chen, Mathematics, HKUST

On Bayesian Models for Stochastic Regression

We adopt Bayesian approach to analyzing a control problem in a simple stochastic regression model and show that under fairly general conditions the Bayesian estimates of the regression parameters are consistent and the control rules converge to the optimal ones.

Sung Nok Chiu, Mathematics, HKBU

Johnson–Mehl Tessellations: Asymptotics and Inference

Consider a set of distinct, isolated points, called *seeds*, in a continuous space. A seed at x_i will be stimulated after a time t_i. A seed, once stimulated, immediately tries to germinate and at the same time to prohibit other seeds from germination by generating a spherical inhibited region the radius of which grows at a positive speed v. A seed stimulated at time t_i fails to germinate if and only if its location has been inhibited on or before t_i. The set of locations first inhibited by the growth of the inhibited region originated from x_i is called the cell of x_i. The space will be partitioned into cells and this space-filling structure is called the Johnson–Mehl tessellation.

In this talk we consider the distribution of the time until the cube $[0, L]^d$ is totally inhibited. It has an extreme value distribution, provided that seed locations and stimulation times form a spatially homogeneous Poisson process in $\mathbb{R}^d \times [0, \infty)$. In particular, for $d = 1$, we explain how to obtain the exact distribution of this time by transforming the original process to a Markov process. Moreover, we discuss the number of germinations within $[0, L]^d$. A central limit theorem for this number is

shown for the case that seed locations and stimulation times form a Poisson process and then extended to the case that the seed locations are m-dependent.
The second part of the talk is devoted to the estimation of the speed v and the intensity measure (on the time axis) of the Poisson process. The maximum likelihood estimation for v, a nonparametric estimation for the intensity measure and for its density, and the maximum likelihood estimation for the parameters of the intensity with known analytical form are proposed and applied to real neurobiological data.

Kwok Pui Choi, Mathematics, National University of Singapore
Poisson Approximations via the Chen-Stein Method and Applications to Computational Biology
In 1974 Louis H Y Chen adapted Stein's normal approximation (1970) to Poisson approximation for dependent indicators. Since then, the techniques have been further developed and extended to many other distributions, notably compound Poisson approximation and Poisson process approximation.
In this talk, we will first outline the Chen-Stein method. Then, we describe a problem of detecting non-random clusters of palindromes in the genomes of herpesvirus families. Motivated by this problem, we will then indicate how to extend the Chen-Stein method to Poisson point process approximation. This provides a mathematical basis for using scan statistics to identify regions of unusually high concentration of palindromes. These regions have been biologically associated with replication regions of these viruses. This is based on a joint work with Louis H Y Chen, Ming Ying Leung and Aihua Xia.

August Chow, Office of the Commissioner of Insurance, HK Special Administrative Region
The Insurance Regulatory Regime in Hong Kong (with an emphasis on the actuarial aspect)
This talk is about:

1. An overview of the insurance regulatory system in HK.
2. Regulations specific to actuarial matters, including the Appointed Actuary system.
3. Guidance note on reserving for investment guarantees.

Cheng-Der Fuh, Institute of Statistical Science, Academia Sinica, Taipei
Iterated Random Functions
Let $(\mathbf{X}, d)$ be a complete separable metric space and $(F_n)_{n\geq 0}$ a sequence of i.i.d. random functions from $\mathbf{X}$ to $\mathbf{X}$ which are uniform Lipschitz, that is, $L_n = \sup_{x\neq y} d(F_n(x), F_n(y))/d(x,y) <_1$ a.s. Providing the mean contraction assumption $\mathbf{E}\log^+ L_1 < 0$ and $\mathbf{E}\log^+ d(F_1(x_0), x_0) < \infty$ for some $x_0 \in \mathbf{X}$, it is known that the forward iterations $M_n^x = F_n \circ ... \circ F_1(x)$, $n \geq 0$, converge weakly to a unique stationary distribution π for each $x \in \mathbf{X}$. The associated backward iterations $\hat{M}_n^x = F_1 \circ ... \circ F_n(x)$ are a.s. convergent to a random variable $\hat{M}_\infty$ which does not depend on x and has

distribution π. Based on the inequality $d(\hat{M}^x_{n+m}, \hat{M}^x_n) \leq \exp(\sum_{k=1}^n \log L_k) d(F_{n+1} \circ ... \circ F_{n+m}(x), x)$ for all $n, m \geq 0$ and the observation that $(\sum_{k=1}^n \log L_k)_{n \geq 0}$ forms an ordinary random walk with negative drift, we will provide new estimates for $d(\hat{M}_\infty, \hat{M}^x_n)$ and $d(M^x_n, M^y_n)$, $x, y \in \mathbf{X}$, under polynomial as well as exponential moment conditions on $\log(1 + L_1)$ and $\log(1 + d(F_1(x_0), x_0))$. It will particularly be shown, that the decrease of the Prokhorov distance between $P^n(x, \cdot)$ and π to 0 is of polynomial, respectively exponential rate under these conditions where P^n denotes the n-step transition kernel of the Markov chain of forward iterations. Applications to a stochastic intensity model in finance is given.

Fu Zhou Gong, Institute of Applied Mathematics, Chinese Academy of Sciences

Probability Analysis of Target Zones for Exchange Rates

The aim of this talk will be to report on some quantitative results for the target zones of exchange rates in a small open economy based on the paper jointed with Qin Liu and Huiming Zhao. A stochastic differential equation (SDE for short) of exchange rates is established from the model under the equilibrium in goods and money markets based on a variation of R. Dornbusch's model [1976]. This model also contains several kinds of macroeconomical shocks and a non-economical factor with its shock which are usually ignored by other authors. Using the theory of SDE in probability theory, we calculate the probability that the nominal exchange rates reach the boundaries of the target zones for the first time, and the mean time that the nominal exchange rates stay in any interval of the target zones. Furthermore, we analyze the effects on them from the elasticity of premium rate of exchange rates, the fundamental, and the standard deviation of the shocks etc.. Using our explicit expression of the fundamental and the definite relations concerning with several important macroeconomical variables, the shocks, and a non-economical factor, we analyze the effects among them.

Minggao Gu, Statistics, CUHK

Probit Models for Handicapping Horse Racing

Since the fundamental work of Bolton and Chapman (1986), much effort has been devoted to improve the multinomial logit model to exploit inefficiencies in horse race wager markets. In this paper, we consider models that are based on the assumption that the horse's utilities follow normal distributions. We call such models probit models. We show that probit models are more attractive and efficient than the logit models for the horse race wager market in Hong Kong. We overcome the computational difficulties associated with the probit model by applying the Markov chain Monte Carlo (MCMC) stochastic approximation algorithm developed in Gu and Zhu (2001). A MCMC likelihood ratio procedure for testing parameters is also devised. We apply our procedures to a data set composed of 1000 races from Hong Kong jockey club during the 1998 to 2000 seasons. Hold-out simulation betting shows a significant improvement for the probit model over the logit

model.

Inchi Hu, Information & Systems Management, HKUST

Irreversible Multi-Armed Bandit Problem with Applications

Motivated by application in computerized adaptive tests, we consider the following sequential design problem. There are J jobs to be processed according to a predetermined order. A single machine is available to process these J jobs. Each job under processing evolves stochastically as Markov chain and earns rewards as it processed, not otherwise. The Markov chain has transition probabilities parameterized by unknown parameter. The objective is to determine how long each job should be processed so that the total expected rewards over an extended time interval is maximized. We construct a class of efficient strategies based on the theory of sequential testing. The example from computerized tests will be discussed and analyzed using the method described in this talk.

Yaozhong Hu, Mathematics, University of Kansas

Optimal Consumption and Portfolio in a Stochastic Volatility Market

A fractional Brownian motion is a special Gaussian process. It is neither a Markov process nor semimartingale. Partly because of these unpleasant properties it has found important applications in many areas. Since it is not a semimartingale the well-known stochastic calculus applicable to semimartingale cannot be applied to it. The first part of this talk presents a stochastic calculus theory for the fractional Brownian motion based on "Wick product".

Then it is applied to deal with an optimal consumption and portfolio problem in a market where the volatility is itself random and modeled by a stochastic differential equation driven by fractional Brownian motion. Explicit solution is found by solving a stochastic partial differential equation.

Hsien-Kuei Hwang, Institute of Statistical Science, Academia Sinica, Taipei

Phase Changes in Random Recursive Structures

This talk is a selective survey based mainly on my recent research on some phase changes appearing in random discrete structures that are recursive in nature. The phenomena to be presented include changes from Poisson to non-Poisson, from Poisson to negative binomial, from Poisson to normal, from Poisson to degeneracy, from normal to non-normal, from normal to non-existence, etc.

Bing-Yi Jing, Mathematics, HKUST

On Self-Normalized Moderate Deviations for Independent Random Variables

In this talk, I give some recent results on self-normalized moderate deviations for independent random variables. Some applications on the laws of iterated logarithms (LIL) for self-normalized

sums and increments are also considered.

Yue-Kuen Kwok, Mathematics, HKUST

Multi-state Lookback Options

The lookback feature in an option contract refers to the payoff structure where the terminal payoff depends on the realized extreme value of the underlying state variables. Lookback options provide the opportunity for the investors to realize attractive gains in the event of substantial price movement of the underlying assets during the life of the option. In this talk, the pricing and hedging issues of European and American style multi-state lookback options will be addressed. For the European style lookback options, we illustrate the use of the rollover hedging strategy in the derivation of the price formulas. The strategy stems from the financial intuition that involves the choice of a sub-replicating portfolio and the subsequent replenishing strategy to achieve full replication of the option payoff. The characterization of the early exercise policies of the American quanto lookback options will be examined.

Tze Leung Lai, Statistics, Stanford University & Mathematics, HKU

Boundary Crossing Probabilities for Moving Averages and Their Applications

Large and moderate deviation approximations are developed for boundary crossing probabilities of moving averages of independent or Markovian random variables and other dependent sequences. These approximations are used to derive both the asymptotic extreme-value distribution of scan statistics and the asymptotic exponential distribution of waiting times to false alarm in sequential change-point detection. Applications to fault detection and biomolecular sequence analysis as well as Monte Carlo counterparts of these approximations are also discussed.

Szu-Lang Liao, Banking and Financial Markets, National Cheng-Chi University

On the Implementation of Continuous-Time Interest Rate Models

Under multi-factor Gaussian Heath-Jarrow-Morton framework, instead of using short-term rate, bond price or forward rate to construct a tree, our methods use the forward prices of underlying assets to build binomial or trinomial forward-price trees. Based on the forward-price trees, we construct binomial or trinomial implied spot-price trees that can be used in the numerical valuation of European- and American-style equity derivatives which are sensitive to interest rates. These tree methods can be implemented with arbitrary deterministic volatility functions of forward rates and underlying assets and are efficient in pricing long-term contingent claims under stochastic interest rates.

Tiong Wee Lim, Statistics & Applied Probability, National University of Singapore

Asian Options: European, American, Arithmetic and Geometric Averaging

First, we demonstrate a recursive integration technique for pricing European-style Asian options, whereby a multidimensional integral in the pricing formula is replaced by a recursive sequence of one-dimensional integrals involving the univariate normal distribution. Second, we analyze American-style Asian options by deriving a canonical optimal stopping problem from which early exercise boundaries can be obtained, and developing a decomposition approach to evaluate American-style Asian option values as the sum of European-style Asian option values and a corresponding early exercise premium. We show how the recursive integration technique can be used on the computation of this premium. Asian options based on both arithmetic and geometric averaging are discussed in this talk.

Shiqing Ling, Mathematics, HKUST

Maximum Likelihood Estimator of Change-Point in ARMA-GARCH Models

This paper investigates the maximum likelihood estimator (MLE) of structure-changed ARMA-GARCH models. The convergent rates of the estimated changed-point and other estimated parameters are obtained. After suitably normalized, it is shown that the estimated change-point has the same asymptotic distribution as that in Picard (1985) and Yao (1987). Other estimated parameters are shown to be asymptotically normal. As special cases, we obtain the asymptotic distributions of MLEs for structure-changed GARCH models, structure-changed ARMA models with structure-unchanged GARCH errors, and structure-changed ARMA models with i.i.d. errors, respectively. Even in these special cases, our results are new contributions to the literature. The auxiliary result on the uniform consistency of the partial-sample MLEs of parameters in ARMA-GARCH models is of independent interest. Some Monte Carlo results are reported and an application to the Hang Seng Index of Hong Kong stock market from 21/05/1996-20/05/1998 is given.

Qi-Man Shao, Mathematics,University of Oregon & National University of Singapore

Self-Normalized Limit Theorems in Probability and Statistics

The normalizing constants in classical limit theorems are usually a sequence of real numbers. It is well-known that moment conditions or other related assumptions are necessary and sometimes sufficient for many classical limit theorems. For instance, a necessary and sufficient condition for a large deviation result is that the moment generating function is finite in a neighborhood of zero. The law of the iterated logarithm holds for i.i.d. random variables if and only if the second moment is finite. However, the situation becomes very different if the normalizing constants are a sequence of random variables. In this talk we shall show that many classical limit theorems remain true for the self-normalized sums of independent random variables under much weaker moment conditions than those required in the classical limit theorems. For instance, a self-normalized large deviation

result holds without any moment condition and a self-normalized exponential non-uniform Berry-Esseen bound is achievable under finite third moments. Applications to the Student t-statistic will be discussed.

Sai Wan Elias Shiu, Statistics and Actuarial Science, University of Iowa & Applied Mathematics, HKPU

Pricing Equity-Indexed Annuities with Dynamic Protection and Optimal Withdrawal

Let $S_1(t)$ and $S_2(t)$ be the prices of two stocks. Consider an American option that provides the amount

$$F(t) = S_2(t) \max\left\{1\ ,\ \max_{0\le\tau\le t} \frac{S_1(\tau)}{S_2(\tau)}\right\}\ ,$$

if it is exercised at time t, $t \ge 0$. The price of stock 2 is provided with a *dynamic protection* that is defined in terms of the prices of stock 1: if $F(t) > S_1(t)$, the instantaneous rates of return of $F(t)$ and $S_2(t)$ are identical. And if $F(t)$ threatens to fall below $S_1(t)$, just enough funds are provided to prevent this from happening. For the two stock prices, the geometric bivariate Brownian motion model with constant dividend-yield rates is assumed. In the case of a perpetual option, closed form expressions for the optimal exercise strategy and the price of this option are given. With these explicit expressions, two general concepts in the theory of option pricing can be illustrated: the smooth pasting condition (high contact condition) and the construction of the self-financed, replicating portfolio. The general result can be applied to two special cases. One case is where the guaranteed level $S_1(t)$ is a deterministic exponential or constant function. The other case is where $S_2(t)$ is an exponential or constant function; here, known results concerning the pricing of *Russian options* are retrieved. Finally, we consider a generalization of the perpetual lookback put option which has payoff $[F(t) - \kappa S_1(t)]$, if it is exercised at time t. This option can be priced with the same technique.

Chun Su, Statistics and Finance, University of Science and Technology of China

On Applications of Limit Theorems to Insurance and Finance

There are consanguineous relationships between the limit theorems in insurance and finance and the heavy-tailed distributions. Deep limit theorems are builded on the deep study properties of heavy-tailed distributions. In this report, we firstly state some developments on the study up on heavy-tailed distributions, such as Classes $\mathcal{L},\ \mathcal{D}, `\mathcal{S},\ \mathcal{S}^*$ and so on; introduce some new Classes of heavy-tailed distributions, such as Classes $\mathcal{M},\ \mathcal{M}^*, `\mathcal{A},\ \mathcal{A}^*$. And then we state some new results on the limit theorems in insurance and finance, such as precise large deviations, ruin probability and some related questions.

Qiying Wang, Center for Mathematics & its Applications, Australian National University

Exact Convergence Rate and Leading Term in Central Limit Theorem for Student's t Statistics

The leading term in the normal approximation to the distribution of Student's t statistic is derived in a general setting, with the sole assumption being that the sampled distribution is in the domain of attraction of a normal law. The form of the leading term is shown to have its origin in the way in which extreme data influence properties of the Studentised sum. The leading-term approximation is used to give the exact rate of convergence in the central limit theorem up to order $n^{-1/2}$, where n denotes sample size. It is proved that the exact rate uniformly on the whole real line, is identical to the exact rate on sets of just three points. Moreover, the exact rate is identical to that for the non-Studentised sum when the latter is normalised for scale using a truncated form of variance, but when the corresponding truncated centring constant is omitted. Examples of characterisations of convergence rates are also given. It is shown that, in some instances, their validity uniformly on the whole real line is equivalent to their validity on just two symmetric points.

Ching-Zong Wei, Institute of Statistical Science, Academia Sinica, Taipei

On the Bayes Control of a Linear Dynamic System

For a linear dynamic input-output system,

$$y_n = \alpha_1 y_{n-1} + \cdots + \alpha_p y_{n-p} + \beta_1 u_{n-1} + \cdots + \beta_q u_{n-q} + \varepsilon_n \ ,$$

where y_i and u_i are the output and the input (controller) at time i. Under the Bayes setting, the prior distributions of $\{\alpha_i\}$ and $\{\varepsilon_i\}$ are known. The goal is to design u_i based on the past information $\Im_i$, so that the first order optimality

$$\lim_{n\to\infty} \frac{1}{n} \sum_{i=1}^{n} (y_i - y_i^* - \varepsilon_i)^2 = 0$$

is achieved.

The Bayes controller u_i takes the form

$$u_i = -\hat{\beta}_{1i}^{-1}(y_i^* - \hat{\alpha}_{1i} y_i - \cdots - \hat{\alpha}_{pi} y_{n-p} - \cdots - \hat{\beta}_{qi} u_{n-q}) \ ,$$

where $\underline{\hat{\alpha}}_i$ and $\underline{\hat{\beta}}_i$ are Bayes estimates based on $\Im_i$.

In this talk we first develop a corresponding theory on the adaptive prediction error squares of a stochastic regression model. The result is then applied to the linear dynamic system. The special feature of our result is that no explicit expression of the posterior distribution of $(\underline{\alpha}_i, \underline{\beta}_i)$ is needed.

Michael Wong, Statistics, CUHK

A Structure Model of Credit Migration

This paper attempts to build a structural model for credit migration. The proposed model is firm specific one depending on two parameters of the firm: the default distance and the credit history of a given firm. The default distance is the logarithmic asset-to-liability ratio, modeled by a Brownian motion, and the credit history is modeled by an occupation time variable. By measuring the duration of a firm staying in a credit rating categories. It becomes possible to describe the general credit performance of a firm in a specific horizon. The proposed model satisfies the empirical observation that there are overlaps of default probability ranges for different credit ratings. A closed-form solution of credit transition probability is also derived under the condition of our model. Using the proposed model with historical transition probability matrix to filter out the subjective thinking of rating agencies is also demonstrated.

Liming Wu, Mathematics, Wuhan University

Essential Spectral Radius of Markov Chains and Applications

Using two new parameters $\beta_\tau(P)$ and $\beta_{wc}(P)$ for a positive kernel P on a Polish space E, we obtain a new formula of Nussbaum-Gelfand type for the essential spectral radius of P on $b\mathcal{B}$. Using that formula we show that different known sufficient conditions for geometric ergodicity such as Doeblin's condition, drift condition by means of Lyapunov function, geometric recurrence etc lead to variational formulas of the essential spectral radius. All those can be easily transported on the weighted space $b_u\mathcal{B}$. Some related results on $L^2(\mu)$ are also obtained, especially in the symmetric case. Moreover we prove that for a strongly Feller and topologically transitive Markov kernel, the large deviation principle of Donsker-Varadhan for occupation measures of the associated Markov process holds if and only if the essential spectral radius is zero. The knowledge of $r_{ess}(P)$ allows us to estimate eigenvalues of P in L^2 in the symmetric case, and to estimate the geometric convergence rate by means of that in the metric of Wasserstein. We pay much attention to different concrete models: 1) forward recurrence time model, 2) reflected random walk, 3) near-neighbor Markov chain on $\mathbb{N}$, 4) linear model on $\mathbb{R}^d$, 5) auto-regresssive model, 6) non-linear random dynamical systems on $\mathbb{R}^d$ etc; for most of them explicit estimates of essential spectral radius and even geometric convergence rate are obtained.

Kai-Nan Xiang, Mathematics, Hunan Normal University

Weak Flows (Dynamics): A New Look at Measure-Valued Processes

It is known that 1-point motion, even 2-point one, of stochastic flows (random dynamical systems) in the existing framework is usually so good that the corresponding flows (dynamics) of homeomorphisms even diffeomorphisms do exist. When one-point or two point motions are "singular", it is difficult or impossible to construct flows (dynamics) of measurable maps for these processes; what

is the right level to study the related "flows or dynamics"? The paper will devote to understanding the question by introducing weak flows (dynamics)—measure evolution processes, which are reasonable and natural replacements for flows (dynamics) of homeomorphic maps in these settings. By the way, a new look at measure-valued processes is given. Here "singularities" may come from badness or degeneracy of generators, boundary effects and irregularities of state spaces, infinite-dimensional phenomena, and random media and the anticipated. The present paper is only at an initial stage, there are many interesting topics deserved to be investigated.

Hailiang Yang, Statistics and Actuarial Science, HKU

On Joint Distribution of Surplus Immediately before and after Ruin

In this talk, we first consider a compound Poisson risk model with a constant interest force. We investigate the joint distribution of the surplus immediately before and after ruin. By adapting the techniques in Sundt and Teugels (1995), integral equations satisfied by the joint distribution function and Lundberg type inequality are obtained. In the case of zero initial reserve and the case of exponential claim sizes, explicit expressions for the joint distribution function are obtained. In the second part of this talk, we consider a risk process in which the claim inter-arrival distribution is an Erlang(2) distribution. We examine the joint distributions of the surplus immediately before ruin and the deficit at ruin again. By adapting the techniques of Dickson and Hipp (2000, 2001), we obtain an explicit expression for the joint distribution.

Xiao-Guang Yang, Institute of System Science, Chinese Academy of Sciences

Optimal Portfolio Allocation under a Probabilistic Risk Constraint and the Incentives for Financial Innovation

We derive, in a complete market environment, an investors optimal portfolio allocation subject to both a budget constraint and a probabilistic risk constraint. We demonstrate that the set of feasible portfolios need not be connected or convex, while the number of local optima increases exponentially with the number of securities implying that finding the optimal portfolio is computationally complex. The resulting optimal portfolio allocation may not be monotonic in the state-price density. A novel type of financial innovation, which splits states of nature, is shown to weakly enhance welfare, restore monotonicity in the state-price density, and may reduce complexity.

Yi Ching Yao, Institute of Statistical Science, Academia Sinica, Taipei

Doob, Ignatov and Optional Skipping

In this talk, I'll first review the literature on Ignatov's theorem (concerning independence of k-record processes), and then describe a general set of distribution-free conditions under which an iid sequence of random variables is preserved under optional skipping, which is motivated by theorems of Doob (1936) and Ignatov (1977).

Zhiliang Ying, Statistics, Columbia University

Hazard Modeling with Applications to Finance, Marketing and Insurance

In this talk, I will give an overview of hazard function-based models and its associated martingale techniques. Its historical ties to the actuarial science, revolutionary developments in survival analysis and more recent applications in finance and marketing will be summarized and discussed.

Frank Zhang, Derivative Research at Morgan Stanley, New York

Credit Modeling and the Simulation of Correlated Defaults

Trading in credit derivatives has increased by an order of magnitude in the last three years. The explosion has been driven by various factors not limited to convenience, greater investor recognition of the functional similarities with credit products, improved standardization of credit events, better guidance from regulators, an increase in active risk management, more rational credit pricing and strong growth in the underlying credit markets.

We address the modeling and computational challenges posed by some of the more complex credit sensitive instruments. Basket default swaps and other pooled and tranched credit sensitive products depend crucially on a reference portfolios which may contain hundreds of names. Not only the number of defaults, but also their timing and order is important. We describe efficient compensator algorithms for rapidly simulating default times in a reduced form ("intensity") model.

Lixin Zhang, Mathematics, Zhejiang University

Strong Approximations of Martingale Vectors and Applications to Markov Chain Adaptive Designs

The strong approximations of a class of $\mathbb{R}^d$-valued martingales are considered. The conditions used in this paper are more easy to check than those used in Eberlein (1986) and Monrad and Philipp (1991). As an application, the strong approximation of a class of non-homogenous Markov chains is established, and the asymptotic properties are established for the multi-treatment Markov chain adaptive designs in clinical trials.

Xunyu Zhou, Systems Engineering & Engineering Management, CUHK

Continuous-Time Mean – Variance Portfolio Selection

This talk reports research that attempts to faithfully extend Markowitz's Nobel-prize winning mean–variance portfolio selection model to the continuous-time setting using an indefinite stochastic linear–quadratic control approach that has been developed very recently. Models with time-varying deterministic market parameters, with random market parameters that are adapted to the underlying Brownian motion (used to define the stocks), with random Markov-modulated market parameters that are independent of the Brownian motion, and with short-selling prohibition are respectively discussed. In all the models, explicit forms of efficient portfolios and efficient frontiers are presented. While many results in the continuous-time Markowitz world are analogous

to their single-period counterparts, there are some results that are strikingly different. One of them is that the market portfolio is no longer efficient in the continuous-time case which has, in turn, impact on the corresponding capital asset pricing model. A number of examples are given to illustrate the similarities as well as differences between the continuous-time and single-period settings.